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STEP 3.2500

AUTHOR: Lemekhova, Ye. N.

TITLE: Delaunay's method in application to the motion of lunar artificial
            satellites

SOURCE: Akademiya nauk SSSR. Institut teoreticheskoy astronomii. Byulle-
            ten'. v. 8, no. 7 (100), 1962, 512 - 530

TEXT: The mass and figure of the Moon can be exactly determined by ana-
lyzing the motion of lunar artificial satellites taking into account perturba-
tions induced by the gravitational effects of the Earth and the Sun. The present
article has the purpose of calculating these effects using Delaunay's method ap-
plied by him to the motion of the Moon [Mém. Acad. de Sc. de France, v. 23, 29
(1860, 1867)]. The author considers the motion of three fictitious artificial
satellites of zero-mass in the plane of the lunar equator along the orbits with
eccentricities of 0.18 at distances 2, 4 and 8 lunar radii from the Moon, respec-
tively. The first problem dealt with is the motion affected by perturbations
due to the Earth. As the problem is analogous to that investigated by Delaunay,
his method of expanding the perturbation function R and analyzing consecutively

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the effect of each of the periodic terms, is applied to the solution of the pre-
sent problem. Restricting the demand on the accuracy of determining selenocen-
trical coordinates of the satellites, V (longitude) and U (latitude), to $0°.01$
and that of $\frac{a}{r}$ (a - semimajor axis of the lunar orbit) to 0.0001, the author de-
rives formulae for calculating all these three quantities for three variants of
satellite distance from the Moon (Formulae 26 - 28). An analysis of accuracy
warrants the conclusion that application of Delaunay's method is justified for
lunar equatorial satellites moving in orbits not exceeding 8 lunar radii and hav-
ing eccentricities not over 0.275. On the basis of the formulae derived, Tables
4, 5 and 6 are compiled for numerical values of coefficients of inequalities due
to Earth's perturbations for the same quantities V, U and $\frac{a}{r}$. The second problem
deals with the motion of the same satellites affected by perturbations due to the
Sun. Since the perturbations by the Sun are considerably smaller than those by
the Earth, the formulae for V, U and $\frac{a}{r}$ are simpler than the corresponding formu-
lae for the former case (Formulae 29 - 31). On the basis of these formulae the
numerical values of coefficients of solar inequalities are calculated and pre-
sented in Tables 10 (longitude), 11 (latitude) and 12 ($\frac{a}{r}$). There are 2 figures
and 12 tables.
SUBMITTED: July 22, 1961
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